FAA AVIATION NEWS

NOVEMBER 1970

COVER

Frozen snow means no go. Important reasons for giving your plane a quick brushoff are given on page 4.

FAA AVIATION NEWS

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Winter Cough

The "throat" of your aircraft engine is particularly vulnerable to icing in wintertime, over a broad temperature range. The remedy for removal of carburetor ice varies according to the engine design.

Carburetor icing does not require subfreezing temperatures, as structural ice obviously does. In a sense, the ordinary carburetor is a small refrigerating unit, capable of bringing about a temperature drop of as much as 75°F. (40°C.) in less than a second. A considerable amount of engine heat may be needed to offset this cooling capacity, once lowered air temperatures are encountered, either from seasonal or altitude changes.

With *float* carburetors, air entering the carburetor passes through a metal tube (venturi) which is narrower at the throat than at either end. Nozzles in the throat provide for vaporization of fuel. This vaporization process absorbs heat — as does the expansion of air, to a lesser extent—thereby chilling the venturi. If the temperature falls below the freezing point, any moisture in the air will be deposited as ice within the carburetor. Ice may form at any point from the airscoop to the engine outlet. Furthermore, if there is water in the fuel, it may cause icing of the fuel nozzles or throttle valve.

Most carburetors are susceptible to icing throughout a temperature range from about 14°F. to 77°F. (−10°C. to 25°C.). At temperatures below 14°F. any moisture in the air is likely to be already frozen and will pass on through the carburetor without sticking to metal parts. The greater the relative humidity, of course, the greater the danger of icing—60 percent or above constitutes the more serious danger zone.

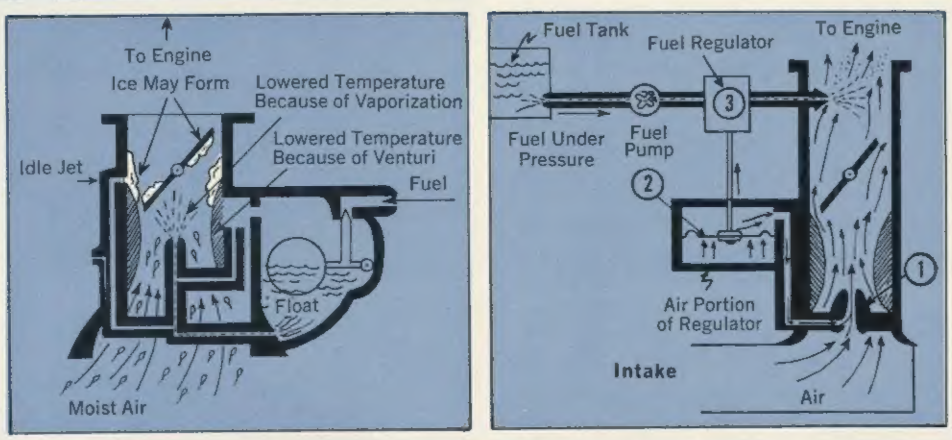
Preliminary signs of engine icing are a suspicious drop in engine rpm when flying a fixed-pitch propeller aircraft, or a loss of manifold air pressure in a constant-speed propeller engine. Later, if the pilot has dozed through these warning signals, he may find his engine coughing violently from fuel starvation, possibly detonating or backfiring from overleaning, and eventually stopping as the ice buildup in the carburetor chokes the life out of it.

Most pilots are schooled to use carburetor heat as standard procedure to prevent ice formation during the landing approach and whenever power is significantly cut back. The carburetor heater uses engine heat to warm the air before it enters the venturi. During low power operation the rpm or manifold pressure losses from accumulation of ice deposits in the carburetor are almost impossible to detect on the engine instruments. Also, the amount of engine heat available is less when the power setting is low, and removal of any large ice buildups can be expected to take longer if preventive heating is not used.

Pressure carburetors are less susceptible to icing in the venturi throat because their fuel nozzle is positioned beyond the throttle control. With *fuel injection* engines, of course, the nozzle sprays the fuel directly into the cylinder head; vaporization icing is even less likely. However, regardless of the carburetor type, structural icing blocking the airscoop is always a possibility and may call for carburetor heating.

With some aircraft, the recommended deicing technique is to go to full rich mixture and gradually apply full carburetor heat. With this type of engine, the first place that ice begins to form is around the fuel discharge nozzle, causing a leaner-than-desired fuel/air mixture. Enriching the mixture may bring the amount of fuel available to the engine back to a more correct fuel/air ratio; any extra fuel will have a cooling effect in the engine cylinders and possibly aid in the suppression of detonation should cylinder-head temperatures rise after introducing hot air (carburetor heat) into the system.

Because of the great variety of carburetors available to general aviation and their essential differences in design, it is important for pilots to realize that no set technique for ice removal or prevention is possible. A remedy that worked for years with one type of aircraft may work harm with another one. The only safe guide is the recommendation of the manufacturer. Don't take any hot tips from strangers. ■



Two diagrams show how the float carburetor (left) differs from the pressure carburetor. In the float type, fuel is drawn from nozzle in throat by incoming air. Pressure type is usually immune to vaporization ice because fuel nozzle is positioned past throat.

Ground ICE

The ten day skiing holiday had been just about perfect—cold snappy nights and bright sunshiny days for the most part, with just enough snowfall to keep the slopes well covered. But now it was Monday morning and the pilot/skier from San Francisco was due back in his office by 9 o'clock, so he hastily dumped his skis and boots in the cabin of the Cherokee Six and began brushing snow off the wings and fuselage—until he hit solid ice. The sleek aluminum wings that had borne him up to the fantastic heights of Squaw Valley were now coated with a washboard layer of ice. How come?

The explanation was simple. The snowfall of last week had melted in the delightfully warm sunshine that followed, leaving a sodden mass that had frozen during the night into a hard, irregular coating. Insulated by a later light snowfall, the ice layer on the plane had retreated slightly, like a reluctant glacier, but still covered the cowl, most of the wing and much of the tail. And it would not come off.

The pilot came to this surprising conclusion after efforts to pull ice loose with his fingernails had drawn blood and curses to no avail. The screwdriver he found in the cockpit was only a little more effective, but it was obviously going to do more damage to the aircraft skin than to the ice.

With a nervous glance at his watch and the rising sun, the pilot/skier dashed into the airport office and blurted out his problem to the group of flyers sitting around the pot-bellied woodstove. What should he do?

"Have a cup of coffee."

"Well, thanks, but—no time. How can I get the ice off my plane?"

"Put it in a heated hangar."

"Have you got one here?"

"Nope."

"Well, what should I do? I ought to be taking off now."

"Don't."

"I've *got* to. You don't understand—my partner's supposed to start on *his* vacation this morning. There must be something I can do—?"

"Up your insurance."

This kind of advice is not helpful to the warm weather pilot who finds himself stuck with an ice machine instead of a flying machine when time is of the essence. But facts are as hard and unrelenting as the ice itself: at most general aviation airports there is literally no way of safely removing a solid coating of ice from the surface of an airplane other than to expose it to warm air, provided either by a heated hangar or by the rays of a friendly sun—usually a much longer and tantalizing process, since the fuel in the tanks which you carefully topped after landing tend to act somewhat as a refrigerant to the wing. (Engine preheaters or blow torches or other heating devices should *never* be used to remove ice, because of the danger of damaging surfaces and controls, as well as causing fire.)

Inflight icing is a phenomenon which most pilots who have to fly IFR are familiar with. But the icing problems which arise from leaving an aircraft tied down in the open at an airport where the temperature drops well below freezing at night—such as a ski resort, a mountain hunting area, etc.—are more serious than many southland pilots expect.

Most surprising of all, perhaps, is the fact that under marginal conditions as little as a quarter of an inch of frost on the wings and tail of a light plane can mean the difference between a successful takeoff and a painful sitzmark in the snow. Frost produces an extremely rough surface, compared with the normally smooth skin of the airplane, and thereby robs it of some of its lift characteristics by disturbing the flow of air over all of the affected airfoils—the propeller as well as wings and horizontal stabilizer.

Frost or ice coating over the radio antenna, incidentally, can interfere with navigation or communication signals or block them off entirely under some circumstances. A relatively light coating of frost is all that is needed to seal off the pitot tube and static ports, rendering airspeed and other air-driven instruments inoperative. The stall warning device could be frozen in place by a very slight touch of frost. A partial ice blocking of the air scoop could have a devastating effect on available horsepower.

Even where no visible ice appears on the aircraft that has been tied down in an area of subfreezing temperatures, there is a danger that daytime thawing has melted

The plastic windscreen of an aircraft is more vulnerable to ice scrapers than the glass of a car. Approved ice removal solutions are the best means of clearing off the pilot's view.

snow or ice and allowed droplets of water to dribble into hidden crevices and hinge joints. After refreezing during the night, the mobility of control surfaces or braking action could be adversely affected. The cold weather preflight should make certain that all controls have full extension range, and that the brakes are not jammed or otherwise hampered by ice. Attempting a takeoff when the wheels will not spin freely is asking for trouble.

If the windscreen of an aircraft becomes coated with frost or ice, it should be treated with care. Aircraft windows are made of plastic, in contrast to the glass used in automobiles, and may not be chipped away at without danger of damaging the material. The type of sprays used to help remove ice from automobile window glass—usually based on isopropyl alcohol—are helpful on aircraft windscreens.

Transport aircraft that come into an airport laden with ice are often washed down with a mixture of isopropyl alcohol and glycerine ("glycol"). The alcohol lowers the freezing point of water, thereby melting the ice, and the glycerine provides a less adherent surface that discourages refreezing and encourages runoff. This operation requires large tanks and heavy equipment, not normally available at small airports.

Numerous experiments have been conducted by industry to develop a coating or paint which would repel ice formation or at least make it easier to shed ice from the surfaces of an aircraft. FAA recently studied 23 such materials, including varieties of Teflon, polyurethane, and silicone—in spray, film, paint, grease and other forms—to determine their practical value to pilots.

Aircraft surfaces were studied in a wind tunnel with simulated airspeeds of from 110 to 150 K with a temperature range from 14°F. to 25°F. Liquid water was sprayed, both intermittently and continuously, in small droplets (15 to 25 microns).

Results were largely negative. No material evaluated during the test program exhibited any anti-icing properties. Ice formation began simultaneously on both the unprotected surface and the treated area during each test run. None of the areas showed a tendency to shed ice, during or after the buildup.

On the other hand, all of the test materials reduced the *force required to release ice* from a treated aluminum surface. The ice adhesion forces ranged from 1.8 pounds per square inch for cationic silicones to 36 pounds per square inch for polyurethane coatings. By way of comparison, the ice adhesion force for untreated aluminum surfaces is in the order of 200 pounds per square inch. Figuratively, this means that the adherent force of the ice covering a two-by-five inch patch on the wing is roughly equivalent to the force a one-ton elephant would need to adhere to the underside of an aircraft wing by the end of his trunk.

This gives a rough idea of why it is so difficult to remove ice that is solidly frozen to your airplane, and why hangaring is so desirable in cold country. As an alternative, the aircraft may be covered with canvas or plastic material. This will not always prevent some icing or frost formation, but it will stop the process of snow alternately piling up on the wing, thawing and freezing. The very least a pilot can do, if he hopes to be able to fly away home promptly when his sojourn in the north woods ends, is to brush his airplane down (gently but thoroughly) after a snowfall.

In the interests of safety he will be well advised to allow plenty of time for preflighting any aircraft that has been standing outdoors in the freezing weather, and be flexible enough to re-schedule his departure if there is hard ice or frost coating the engine, propeller, wings, windows or tail. The modern light aircraft is precisely designed to operate in its normal configuration, and any tampering with the design by the unpredictable Jack Frost could prolong your stay in his stronghold undesirably.

Lewis Gelfan

Snow left to accumulate on light aircraft may partially thaw by day and freeze overnight, forming a tight bond with the surface of the plane. Several hours storage in a heated hangar or a long nap in the warm sun are the only solutions to this problem.

Bottom—attempting to start up an engine in this condition could damage it severely through ice ingestion. Slight accumulations on propeller could unbalance it sufficiently to cause vibrations and internal wear. Right—surfaces of large aircraft are frequently sprayed with alcohol-base compounds to remove accumulation before takeoff.

The research report, "Investigation of Ice Accretion Characteristics of Hydrophobic Materials" (FAA-DS-70-11) is sold for $3 by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151.

INSPECTION AIDS 3

Series of articles on maintenance problems of general aviation aircraft.

Flexible air intake hose is made of plastic reinforced with spring steel. Material may be damaged during removal or replacement of cowl.

Breath of Life

Although often only a few inches in length the flexible air intake hose is a vital and vulnerable engine component.

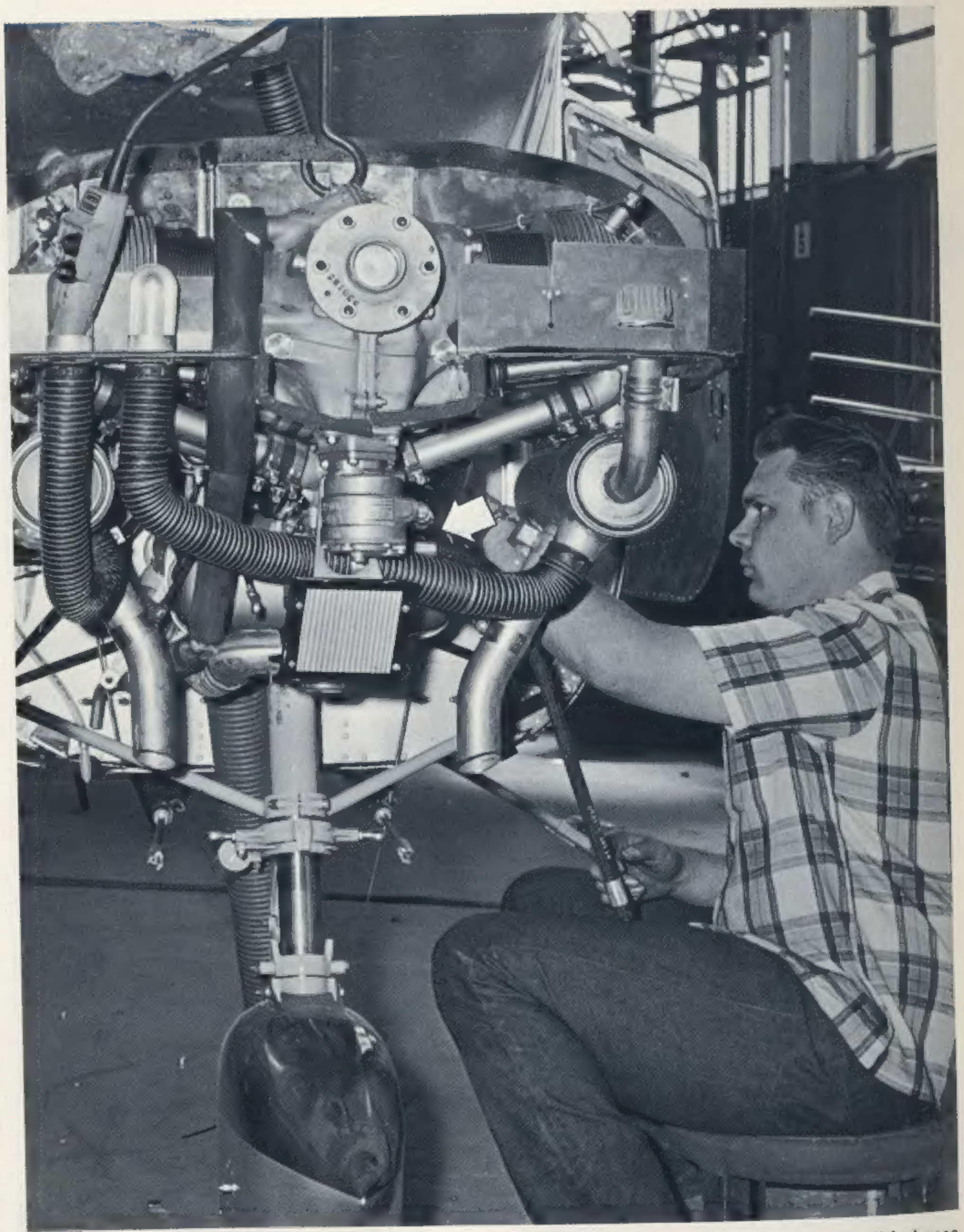
Aircraft engines must breathe air to function, even as you and I. Any restriction of air flow to the carburetor may affect the engine in the same manner as a constriction of the windpipe would hamper the flow of air into the lungs of a human being. For many general aviation aircraft, the component corresponding to the human windpipe is the flexible hosing that connects the air scoop with the carburetor air intake.

FAA has received frequent reports concerning loss of engine power due to collapsed or broken air hoses. Such loss of power on takeoff can be critical. Insufficient air in the fuel mixture results in an overly rich mixture and a loss in rpm. Pilots can guard against this hazard by making it a habit to inspect the air induction system periodically during the preflight check.

Danger signs to look for: broken or frayed wrapping, altered shape of hose, slippage of wire reinforcement or evidence of the wire not being properly bonded to the duct. Make certain that engine vibration has not jarred a hose clamp loose, or jammed a hose against the engine mount struts. Any danger signals should be called to the attention of a licensed engine mechanic.

Replacement air hose is relatively inexpensive—provided the work is done before a weakened engine fails to pull you up over the trees at the end of the runway. Take care of your mechanical windpipe. ■

(Complete sets of FAA Inspection Aids reports on general aviation are available from the Superintendent of Documents, Washington, D.C. 20402. Domestic subscription is $3.00, foreign $3.75.)



Carburetor air intake hose is hidden from view by airscoop screen (arrow). Other flexible hoses transport cabin heat. They are easily punctured by a misdirected screwdriver.

Cloud Ceilings

Scattered clouds do not make up a "ceiling," although they may develop into one very quickly following a windshift or a drop in temperature. Likewise, a "broken" ceiling reported at the airport of arrival could become a solid overcast in a matter of minutes. Do not count on clouds standing still.

SKY AND CEILING

Sky cover symbols are in ascending order. Figures preceding symbols are heights in hundreds of feet above station.

- ○ **Clear:** Less than 0.1 sky cover.
- ⦶ **Scattered:** 0.1 to less than 0.6 sky cover.
- ⦷ **Broken:** 0.6 to 0.9 sky cover.
- ⊕ **Overcast:** More than 0.9 sky cover.
- — **Thin** (When prefixed to the above symbols.)
- -X **Partial Obscuration:** 0.1 to less than 1.0 sky hidden by precipitation or obstruction to vision (bases at surface).
- X **Obscuration:** 1.0 sky hidden by precipitation or obstruction to vision (bases at surface).

Letter preceding height of layer identifies ceiling layer and indicates how ceiling height was obtained. Thus:

- A Aircraft
- B Balloon (Pilot or ceiling).
- D Estimated height of cirriform clouds on basis of persistency.
- E Estimated heights of noncirriform clouds
- M Measured
- R Radiosonde Balloon or Radar
- W Indefinite
- U Height of cirriform ceiling layer unknown
- / Height of cirriform non-ceiling layer unknown
- "V" immediately following numerical value indicates a varying ceiling.

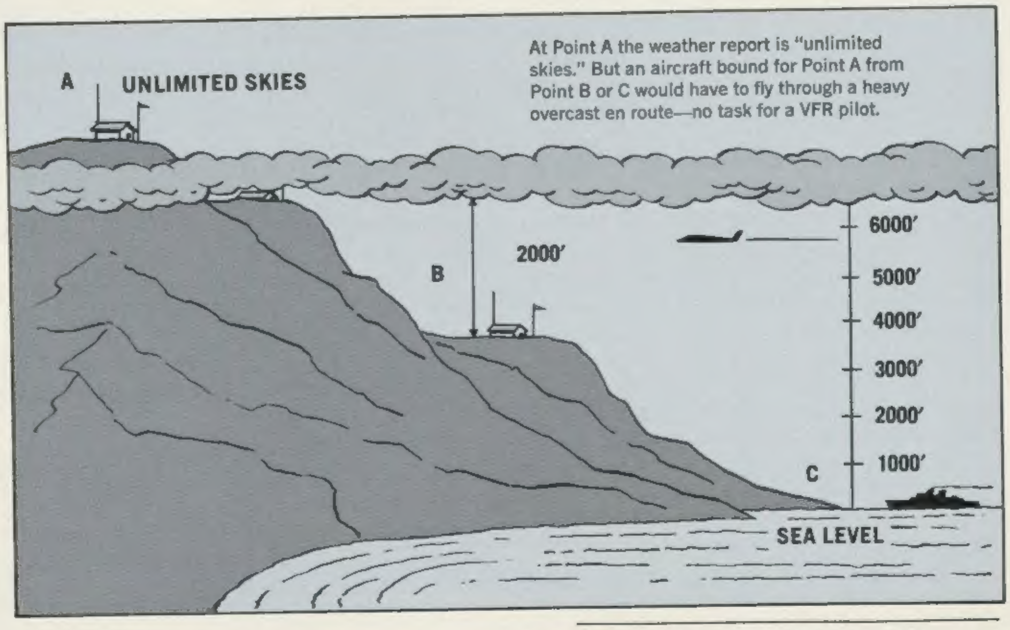
Many pilots get into trouble with weather not because they ignore weather reports but because they fail to understand them properly. A misinterpreted weather report can be more dangerous to flight safety than no report at all. General aviation pilots cannot always expect to have a weatherman or FSS specialist spell out the weather sequences or hourly reports for them; they should be capable of doing this for themselves quickly and accurately and make their own decision about continuing a flight.

Cloud ceilings, for example, are sometimes thought of as simply layers of clouds of varying thickness at various altitudes. But in the weather sequence a ceiling is *the lowest level of clouds at which more than half of the sky is covered* (it can be made up of several layers of clouds) at a particular reporting station. A "broken" (⦷) ceiling covers .6 to .9 of the sky; more than .9 is "overcast" (⊕). If the cloud layer is thin or light, it is not reported as a ceiling. If the sky is partially obscured, no estimate is made for the cloud height.

Therefore it is possible to fly through an area where the tops of some land-based obstructions to flight are veiled by clouds, even though no ceiling is reported. Hence the importance of knowing one's position in relation to the ground at all times.

This is especially true in view of the fact that some high-speed aircraft of today will traverse several hundred miles of rapidly changing terrain in less than an hour. Weather sequences always report ceilings as elevation above ground at the station—which means that a 6,000 foot ceiling reported at sea level could soon present a problem to the pilot bound overland across rising mountain slopes. Similarly, unlimited skies over mile-high Denver could easily be replaced by a heavy overcast for the pilot descending toward a destination on the lower plains of Nebraska.

All of these situations can be handled safely by the pilot who is prepared to anticipate the weather ahead correctly. ■



At Point A the weather report is "unlimited skies." But an aircraft bound for Point A from Point B or C would have to fly through a heavy overcast en route—no task for a VFR pilot.

From the Ground Up

Nearly 700 general aviation accidents—more than a quarter of them fatal—in 1968 have been ascribed to faulty preflight preparation by official investigators of the Federal Aviation Administration and the National Transportation Safety Board. A study prepared for FAA by the Stanwick Corporation has spotlighted the kinds of preflight habits that lead to unsafe flying.

Preflight preparations are by no means limited to the usual walk-around, but include all activities that prepare the airplane and the pilot to deal successfully with the proposed flight.

The kind of flying you do, investigators found, strongly influences the kind of preflight preparations you consider important. If you are a private pilot flying fixed base operator aircraft, for example, you may spend a lot of time visually inspecting the aircraft you rent, but never bother to read over the documents that tell you if the craft is airworthy, how recently it has been overhauled, whether it has been specially modified, etc.

Conclusions of this type were developed on the basis of a random sampling of 3,200 pilots. Stanwick researchers began by separating general aviation pilots into eight categories according to the operator of the aircraft: private owners, flying schools, business aircraft, aerial applicators, air taxi, fixed base operators, government-operated aircraft, and those used by the Civil Air Patrol or by flying clubs. Detailed questionnaires were sent out to determine the extent and the length of time devoted to aircraft preflight, weather briefing, weight and balance, density altitude, flight planning, etc.

This data was carefully related to the 697 accidents officially ascribed to faulty preflight preparation in 1968 by NTSB (excluding student accidents). Stanwick researchers noted that more than 25 percent of these accidents culminated in a fatality and that 82 percent had filed no flight plan. Only 10 of the 697 aircraft were on IFR flight plans. In general, the operating categories most frequently involved in accidents that were preventable by better preflighting showed the fewest positive actions taken during the flight preparation stage.

Private Owners. Pilots who fly their own aircraft commonly commit four major errors with regard to flight preparations: (1) they do not take pains to fully understand the weather conditions forecast en route, (2) they fail to plan adequately for safe fuel use, (3) they fail to inspect carefully for water in the fuel, and (4) they fail to wait long enough after imbibing alcohol before flying the aircraft.

In connection with Point (3) above, many private pilots appeared to be under the impression that merely spilling a few ounces of fuel from the nearest sump onto the ground was an adequate precaution against water-contaminated fuel. To be really safe, all sumps—wing and engine—should be drained into a transparent container until the proper color of fluid for the type of gasoline needed in the aircraft appears. It is not uncommon for sumps to contain more than a quart of water, under favorable circumstances.

Air Taxis. Fuel exhaustion appears to be one of the most obvious blunders attributable to novice pilots—a simple matter of arithmetic. Nevertheless, a disproportionate number of accidents among air taxi operators has been traced to failure to allow for emergency fuel needs. Keeping the gross weight to a minimum for reasons of economy, by skimping on fuel, can mean tempting fate unnecessarily.

Fixed Base Operators. FBOs are known for the flexibility of their operations, their ability to fly anywhere at any time. They are also known, unfortunately (according to the Stanwick report), for a relatively high number of accidents stemming from failure to take into consideration weather conditions and fuel needs, and for setting aircraft down in areas unsuitable either for safe landing or takeoff.

Government Operators. Although accidents in this category were too few to permit any solid conclusion to be drawn, the report's investigation suggested that Federal, State and municipal operator accidents would have been fewer still if greater attention had been given to route and fuel planning.

Civil Air Patrol/Flying Clubs. Major preflight problems in this category were improper fuel planning, VFR flight into known IFR conditions, failing to obtain weather information and flying while under the influence of alcohol.

Flying Schools. This category also had a very low accident rate in connection with preflight causal factors (four accidents in 1968). Two accidents were blamed on poor fuel management and one accident each on foreign matter in the fuel and lack of familiarity with the aircraft.

Business Aircraft. Both full-time professionals and part-time executive pilots are lumped into this category. The preflight errors of omission again center around poor fuel use planning, flying VFR into known instrument weather, and failure of the pilot to familiarize himself thoroughly with an aircraft before embarking on a cross-country flight.

Aerial Applicators. Unsafe preflight procedures in this category include poor fuel use planning, failure to check weight and balance carefully, and inadequate pilot qualification. A special problem with this group concerns selecting suitable terrain for takeoffs and landings.

Improper planning for fuel utilization is apparently the most consistent cause of preflight accidents in the entire range of general aviation pilots. Since adequate planning is such an obvious matter of good practice, and such a relatively simple chore, it may be assumed that the importance of this task is often scanted because some pilots feel confident of cutting down on estimated flight time, or imagine that *they could make time and the fuel gauge needle stand still* while they struggle toward an alternate airport. This is gambling with borrowed time, adding an unnecessary risk to flying.

Indeed, the Stanwick survey concluded that the type of accident associated with faulty preflight procedure is probably the most readily preventable of all types of accidents. Self-deception on the part of the pilot appears to play a vital role in persuading pilots to ignore common sense, simple mathematics, or the realities of weather and time. The most effective checklist ever invented is not proof against this kind of dishonesty. The life you risk is always your own.

Copies of this report, "Study of Preflight Procedures of General Aviation," (FAA-DS-70-10) may be ordered from the Clearinghouse for Federal Scientific and Technical Information, 5285 Port Royal Road, Springfield, Virginia 22154. A check or money order for $3.00 should accompany your request and the reference number AD 705 230 should be used.

Many preventable accidents have their origin in faulty preparations for flying.

The most common error in general aviation flight preparation is poor fuel management. Mistakes include insufficient fueling, use of the wrong grade of fuel, unsecured fuel caps, water in fuel and failure to switch over to full tank. Overseeing fueling of aircraft is pilot's responsibility.

Government-operated aircraft have an excellent safety record. Pilots spend twice as much time on preflight planning and preparation as other pilots.

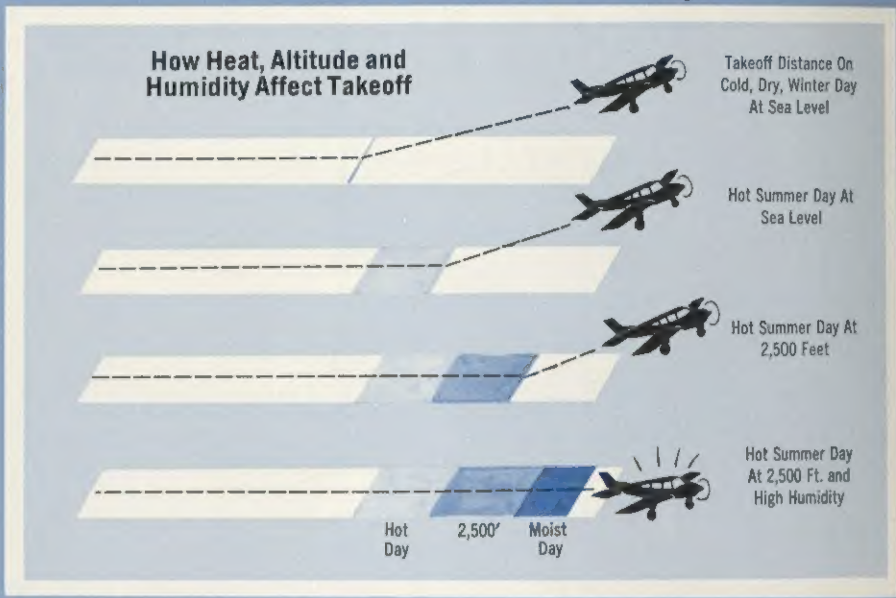
Above—one-third of air taxi pilots quizzed guess at—rather than calculate—the critical weight and balance factors of their load. Below—rigorous attention is given to visual inspection of aircraft at flying schools. Accidents due to faulty preflighting are few in this group—but fuel mismanagement mishaps occasionally occur.

Flying clubs are an excellent means of reducing the cost of flying light aircraft. Glaring preflight weakness in this group is failure to give proper consideration to density altitude on aircraft performance.

The busy executive who flies his own or company aircraft is more likely than other pilots to skimp on time needed to check his fuel carefully for water or other impurities.

WET AIR

When the Absolute Humidity is Relative to the Runway



Many a pilot who has literally sweated out a sluggish takeoff over an immovable obstacle in damp weather has wondered if it was not the humidity rather than the heat that was holding him down. Given the well known fact that bone dry air is much denser than vapor-saturated air, why is humidity not a major factor in determining aircraft performance?

While it is true that water vapor weighs only about five-eighths as much as an equal volume of dry air, it should be understood that no matter how high the *relative* humidity may be, the actual or *absolute* amount of moisture in the air is rather small. Relative humidity means the degree to which a given body of air, at a given pressure and temperature, is saturated with moisture—but even 100 percent relative humidity would not mean that the air is entirely made up of water vapor. It would only mean that the air is holding all the water vapor it is capable of holding.

By actual weight, some of the dampest air measured on earth (at Tafaingata in the Samoan Islands) only contained about .023 lbs. of water vapor for each pound of air—equivalent to each *ton of air* containing a mere 46 pounds of water vapor. In this wringing wet and torrid air over Samoa, a virtual open-air Turkish bath, the loss of lift and thrust-producing density was a relatively insignificant *eight-tenths of one percent*. Obviously we can dismiss any appreciable effect of dampness in the air on the efficiency of the wing in lifting and the propeller in thrusting.

The effect of water vapor on engine power output, however, can be significant, and should be taken into consideration when planning takeoffs in muggy weather.

The Damp Pacific

The combined effects of high temperature and high humidity—which may occur almost anywhere in the United States except in the southwest—can add up to a total loss of as much as 20 percent. This fact was dramatically discovered by B-29 crews operating out of the South Pacific during World War II. Some of the crews on early bombing missions, fully fueled and loaded with bombs, found that they could not climb above a few hundred feet immediately after takeoff. The slide-rule practitioners were quickly called in to consult with the crews. Until that time, no one had really taken a scientific look at the problems of high humidity on power output.

Power loss attributable to the presence of water vapor alone can be as high as seven percent for piston driven engines. That 180-horse mill ahead of you would then be delivering only 167.4 horsepower. Quite a difference.

Even in moderately damp climates, with a typical temperature of 80°F. and relative humidity 90 percent, power loss due to water vapor could still be about 6.5 percent.

Power loss of this magnitude, coupled with lift loss due to the effects of reduced density altitude which accompany hot air, should be cause for concern. Just why is the effect substantial upon the piston powerplant?

There are three reasons. First is the loss in the *volume* of combustible air entering the engine. Secondly, there is an excessive enrichment of the mixture. And there is a "drowning" effect on the burning process itself. (This "drowning" effect results in retarding the flame front speed in the combustion chamber. The effect is similar to retarding the spark ignition point.)

Less air is brought into the combustion chamber because some has been physically replaced by water vapor. The carburetor is still metering the same amount of fuel. Hence, the mixture becomes too rich. The "drowning" effect is not clearly understood, but it is distinguishable in tests.

Jet engines are different beasts, and are not affected nearly as much by water vapor. On a soggy tropical day in Samoa the jet engine will lose only about 0.5 percent of its thrust. Jets lose less power with high water vapor content because they normally run at mixtures far leaner than the typical piston powerplants. Piston engines operate very close to a critical fuel-air mixture ratio—and often just a little on the rich side, for better cooling and extended engine life. The jet engine, on the other hand, normally operates with a fuel-air ratio one-third as rich as the piston engine, or leaner. Enrichment of the mixture in a jet engine as a result of water vapor is, therefore, far less important than in the piston mill.

The effect of water vapor on supercharged piston and injection piston engines is substantially the same as the effect on other piston engines. Fuel injection systems meter fuel on the basis of a given volume of gas entering the combustion chamber, whether that gas is air or water vapor, just as the carburetor does. It cannot discriminate between combustibles and non-combustibles.

Supercharging increases the density of the entire charge entering the induction pipe, so the percentage loss in power for supercharged and non-supercharged engines will be about the same for a given value of humidity.

Liquid-Injection Engines

Water vapor has somewhat less effect upon a liquid-injection engine than it does upon a dry engine because liquid injection engines run farther away from the critical enrichment point than dry engines. It still affects power output as a result of the loss of burnable air that is replaced by water vapor.

If it is not very good for piston engines to be choked up with high concentrations of water vapor. why is it good to inject liquid water into them? Water injection,

Sweating out an unexpectedly close takeoff clearance over high tension wires can give a pilot dank thoughts. Is soggy air harder to fly in?

most often used in high-performance engines, actually increases power output.

Water injected directly into the engine in liquid form provides a heat absorption that makes it possible for the engine to operate, at maximum power output, very close to optimum fuel/air mixture ratios. Cooling requirements for engines operating without liquid injection—cooling to prevent pre-ignition, or "knocking," make it necessary to provide over-rich mixtures at peak power. The resulting loss of power accounts for 6 to 8 percent of the maximum power output that would be possible if the engine could be operated at that temperature and pressure without pre-ignition. By offering the engine the same charge mass, but with evaporated water providing protection against pre-ignition from overheating, the engine can be run up to the ideal full power fuel-to-air ratio. The engine can actually be boosted about 6-8 percent beyond this level, for a cumulative takeoff power gain of about 15 percent.

Will water *vapor* do the same thing? No, because it has already evaporated. With liquid-injection systems, the fluid (usually water or ammonia or alcohol, or a mixture of these) goes into the engine in its *liquid* state.

The liquid, of course, is going to evaporate momentarily, as it drops in pressure and gets mixed up thoroughly with the incoming fuel charge. Water *vapor*, on the other hand, is evaporated before entering, and thereby offers no cooling value to the engine.

The process of evaporation requires heat. The home refrigerator keeps food cool by expanding Freon or other refrigerating substances that pass from liquid to gaseous state in the cooling coils. To make the change, the gases have to absorb large quantities of heat. In a liquid injection aircraft engine, it is this absorption of heat during evaporation that is beneficial—enough to more than overcome the loss in power resulting from the water vapor which then goes through the combustion chamber. Use of alcohol instead of water provides a burnable coolant, but there is some loss in cooling ability too, because few liquids absorb or give off, for each unit of volume, as much heat as water does when passing from the liquid to gaseous state.

Effect on Jet Engines

Surprisingly, jet engines benefit by liquid injection, too. Sometimes it is added to the compressor inlet, and sometimes injected directly into the burner cans.

Just as in the piston engine, evaporation of the water or liquid inside the jet cools the incoming charge, making it more dense and increasing power ouput. Life is easier for the turbine which turns the compressor, and therefore there is more energy left for the jet exhaust. This improvement, added to the increased mass flow as a result of the additional weight of injected water, can boost power output by 10 percent.

Mass flow is important in a jet engine. The thrust forward is exactly equivalent to the thrust rearward at constant airspeed. Any addition to the mass or weight of the flow, without any change in exhaust velocity, means higher performance.

Given an understanding of the power loss that can accompany high water vapor content in the air, how can a pilot tell when there is a lot of water vapor around?

Cold Air Is No Problem

One of the best indicators is that hot and sticky feeling. When air is cold, it cannot hold much water vapor; below 32°F. you have no concern with water vapor at all. With high outside air temperatures, however, the effect of water vapor in the air can be appreciable. As air heats up, its ability to hold water increases dramatically. For each 18°F. (10°C.) increase in temperature, the capacity of the air to hold moisture doubles.

A pilot taking off in air at 60°F. will be flying through air holding twice the moisture of 42° air at the same relative humidity. If the relative humidity holds constant and the temperature rises to 78 degrees the moisture content will double again for a total increase of four times. At 96°, the water vapor content will be eight times as great as at 42°.

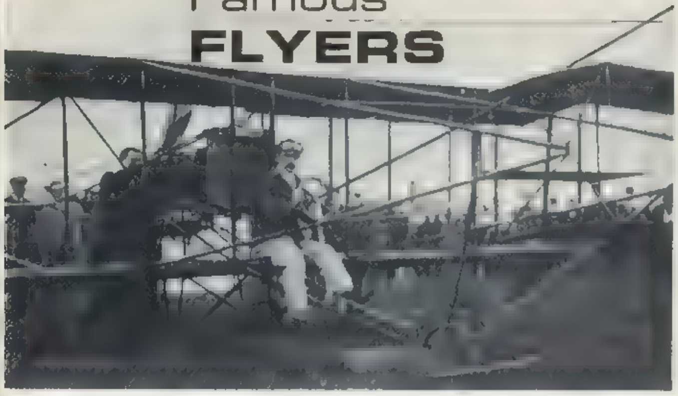
Note that as the relative humidity is held constant in our illustration the absolute humidity changes directly with the temperature. In these comparisons we are not speaking of the same place and day but in fact of different air masses; for example, a 96°F. temperature and 42% humidity might be typical of a summer day in a given locality, while 60°F. and 42% humidity might occur in a different season, or in a much cooler geographic region.

Unfortunately, the actual moisture content is not easy to find. Weather Bureau facilities have the information available, but values commonly available for relative humidity do not tell you what the actual, or absolute humidity of the air is. Relative humidity, as indicated earlier, is an index of how much of the possble wetness of the air is actually being carried.

A rough rule of thumb is to keep moisture content in mind any time you consult your aircraft owner's handbook for takeoff distances, and add another 10 percent for the possible effects of engine power loss due to water vapor. There will be very few runways you cannot get out of, and if it is so close that 10 percent is going to give you a fine margin for error you might want to put the flight off until it is cooler or dryer.

If the humidity, not the heat, is causing your spirits to wilt, think about what it may do to your engine. *D.J.B.*

Famous
FLYERS



Part II of an article on Glenn Hammond Curtiss, who in 1909 stole the spotlight from the Wright brothers on the stage of aviation's dramatic popularization. His victory over Bleriot in the "Coupe Internationale" made him famous overnight.

the FATHER of JENNY

Glenn Curtiss returned to America in 1909 with the title, "Champion Aviator of the World." For the first time, enthusiasm for aviation was felt throughout the United States, and Curtiss was eager to respond to the public mood by producing large quantities of aircraft in his Hammondsport plant. But he was stymied at the onset by a suit for patent infringement—involving the design of aileron control—brought by Wilbur and Orville Wright.

While the legal battle dragged on in the courts, Curtiss was obliged to post a bond for every aircraft he built and sold—the bond to be forfeited if the Wrights won their suit. This put a damper in his manufacturing plans for nearly five years, until the Federal Government intervened and settled the dispute by cross licensing.

In the meantime Curtiss wanted desperately to keep public interest in his aircraft alive. In 1910 he formed a team of skilled pilots and led them on a barnstorming tour of the country, putting on air shows at every country fair and at every crossroad hamlet that would provide an open field and a crowd of gawkers.

As anticipated, the flying exhibitions succeeded in building up Curtiss as a popular hero, and they were financially rewarding. His most successful venture as a publicist, however, came when he competed for a $10,000 prize offered by the *New York World* in 1910 for the first aviator to fly between Albany and New York City. Not only was it to be the first city-to-city flight and the longest on record, but it also placed new demands on pilot and aircraft because of the unfavorable terrain along the Hudson River under the flight path.

Curtiss' entry was his specially designed *Albany Flyer*, measuring 30 feet fore and aft and weighing 1,004 lbs. including fuel and pilot. The *Flyer* was fitted with pontoons covered with cork-filled rubberized fabric for water landing. Curtiss took extra precautions by wearing a cork life preserver.

With his familiar chauffeur's cap he cut an odd figure before the crowd gathered for the takeoff at Albany on May 27, 1910. But Curtiss flew triumphantly from Albany to Governor's Island in 2 hours and 46 minutes at an average speed of 54.18 miles per hour (about five miles per hour faster than the train). The flight achieved tremendous press and public acclaim, with experts asserting it had laid the groundwork for practical air transportation as well as military aviation.

The Aerial Yacht

Overnight, aircraft competitions sprang up all over the United States, with rich prizes in the offing. Curtiss competed with great success and growing fame. But before the year was out, he announced enigmatically that he was giving up exhibition flying to devote his time to experimental work.

For several years he had been studying the possibility of flying from a water surface and had suggested that the "aerial yacht" was the safest kind of aircraft. In 1908 Curtiss had made an unsuccessful attempt at a water takeoff in a *June Bug* model outfitted with two 20-foot canoe-shaped floats, and renamed the *Loon*. Suction created by the speed of the plane's floats had prevented it from leaving the surface of the water, and after springing a leak the *Loon* sank. His new floats were compartmentalized. In further experiments with flying boats in the summer of 1910, Curtiss solved the problem of water adhesion to the hull by designing a wedge-shaped step to facilitate the take-off. Soon he was turning out "aerial yachts" for the gentleman sportsman.

To spur interest in naval aviation, Curtiss arranged for one of his aircraft to land on the deck of a battleship, the U.S.S. Pennsylvania. A tail hook successfully engaged cables on the deck and the aircraft stopped safely. His "hydroterra-aeroplane" or *Triad*, a plane fitted with floats as well as wheels so it could operate from land and water, won great favor with the Navy and won Curtiss the Aero Club's gold medal for "the greatest achievement in American Aviation in 1911." The following year he won the award for his flying boat, *The Flying Fish*. For his marine aviation pioneering he was awarded the Langely medal of the Smithsonian Institution—it weighed one pound and was made of solid gold!

Curtiss built the twin-engined cabin plane *America* in 1914 to compete for the $50,000 "first Atlantic crossing" prize offered by the *London Daily Mail*. The forerunner of modern passenger-carrying aircraft, with a hull 36 feet long, a 72-foot upper wing, a 46-foot lower wing and two 90 hp-OX type engines, it was the first multi-motored flying boat ever built. The outbreak of WW I interrupted the contest and the *America* was sold to the British for patrol work. Later, after the United States entered the war, Curtiss produced the Navy NC 1-4 series, the first aircraft to cross the Atlantic (see FAA AVIATION NEWS, March 1968).

The Allies bluntly asked their new military partner, the United States, to turn out 25,000 warplanes to help win the war! This was an outrageous request considering that fewer than 1,000 planes had been produced in America in the 15 years since Kitty Hawk. With three factories in Hammondsport and two in Buffalo already operating at top capacity, Curtiss built an-

Nancy Four, first plane to cross the Atlantic, taxis into Lisbon Harbor, Portugal, in May 1919. Only one of four-unit Curtiss-built flotilla to reach European shores, NC-4 was a tri-motor flying boat carrying six persons.

America, first multi-engine flying boat was built in 1914 on order from Rodman Wanamaker, wealthy Philadelphia merchant, for entry in trans-Atlantic competition. Outbreak of WW I forestalled early efforts to introduce intercontinental air travel.

The beloved *Jenny*, standard WW I trainer for thousands of American pilots, was first mass-produced aircraft. Curtiss built over 6,700 units of the JN series, later sold off hundreds of remodeled Army surplus *Jennys*.

other factory in 90 days at a cost of $4 million—the largest single airplane factory in the world. Curtiss, now merged with J. N. Willys of automobile fame, had 40,000 employees. By war's end an output of 50 planes a day was almost realized. The Curtiss Airplane and Motor Company had manufactured 11,000 planes and flying boats and 15,000 engines.

Air Corps Favorite

The best known model, the JN4-B with a 100 hp OX-5 engine, could climb 3,500 feet fully loaded in 10 minutes. It weighed 1,430 lbs. empty and carried a 490 lb. load. Light and compact, the *Jenny* was used to train most of the 10,000 American pilots and many British flyers. Over 6,759 were built.

After the War the Curtiss Company brought back some 2,000 war surplus *Jennys*, over-hauled them for civilian use and sold them at a fraction of their original cost. This action gave birth to a new breed of American gypsies who brought romance to flying as they barnstormed around the country. Sleeping in fields as they hopped from town to town, they gave airplane rides for 50 cents a minute and risked their necks in unusual maneuvers. Many died in crashes or in poverty. A few grew rich, some even started their own airlines.

The Curtiss Company soon became such a huge corporate structure that Glenn Curtiss felt lost in it. He dropped his active role in 1921 and moved to Florida, where he grew rich in real estate. In the summer of 1929 the Curtiss interests merged with the Wright Aeronautical Corporation. But a letter sent by Curtiss to the surviving Wright brother, Orville, proposing a friendly visit, was never answered. On July 23, 1930, Curtiss died unexpectedly at the age of 52. following an attack of appendicitis. A tremendous flyover of aircraft honored his burial at Hammondsport.

By a curious whim of history the man who in a comparatively short lifetime had gained international fame as a pilot and aircraft designer and builder, and who had pioneered trans-Atlantic flight, was all but forgotten soon after the dust had settled on his grave. *M.W.*

Pilot BRIEFS

▪ VOLUNTARY TCA AT DCA. A simplified terminal control area (TCA) design for Washington National Airport/Andrews A.F.B. is now in effect on a voluntary basis. Pilot user comment is solicited throughout November, prior to possible rulemaking action. The new design consists of three overlapping circular sections of airspace radiating outward from the two airports at distances of 7, 10, and 15 miles. The ceiling of the area is 6,500 feet, and the floor moves down by steps from 2,500 feet at the outer circle to ground level. There is no VFR corridor. Full details are in AIM, Part 3, October 15. Send comments (in triplicate) to Docket 70-WA-10, Air Traffic Division, FAA Eastern Region, Federal Bldg., JFK International Airport, Jamaica, N.Y. 11430.

▪ AIRPORT TAXIWAY CHARTS. FAA is seeking pilot evaluation of new charts of taxiways at major airports. A packet containing 19 taxiway charts may be examined at flight service stations. A limited number of packets are available free from FAA's Cartographic Standards Branch, AT-420, 800 Independence Ave., Washington, D.C. 20590. Pilot comment should be sent to this address.

▪ COLLEGES WARNED ON CHARTER FLIGHTS. FAA Administrator John H. Shaffer has asked educational and other institutions that charter large aircraft for transporting athletic teams or social groups by air to seek local FAA approval of charter arrangements. The recent fatal crash of a Martin 404 carrying part of the Wichita State University football team has underlined the tragic possibilities inherent in using non-airworthy aircraft or disqualified aircrews.

▪ ECONOMY AIRPORT LIGHTING SYSTEMS APPROVED. Three economy versions of runway lighting systems eligible for FAA grant assistance at qualifying airports are described in a recent agency advisory circular. These systems will permit airport sponsor installation of lights at airports which are not eligible for precision instrument landing system approach lights under FAA's Facilities and Equipment Program. Free copies of AC 150/5340-14B, "Economy Approach Lighting Aids," may be obtained from the DOT/FAA Distribution Unit, TAD-484.3, Washington, D.C. 20590.

▪ DECOMPRESSION TRAINING. The increased use of pressurized cabins in high performance general aviation aircraft calls for pilot awareness of the procedures to be followed in the event of inflight decompression. Periodic exercises involving immediate recourse to emergency oxygen is recommended by FAA's Flight Standards Office for all aircrews who fly regularly above 12,500 feet. If possible, at least one crew member should attend the one-day course in high altitude training offered by FAA's Civil Aeromedical Institute. Write to P.O. Box 25082, Oklahoma City, Okla. 73125.

FAA's "Friendly Persuaders" Program Will Go Nationwide

Accident prevention specialists will be assigned to all 78 General Aviation District Offices throughout the nation, following a successful two-year trial of the program in FAA's Southwest and Central Regions. The program will be in full operation by July 1, 1971.

Originally known as Project 85 (FAA earlier had 85 GADOs), the "friendly persuasion" technique was tried out for the first time in 1968, when 31 experienced general aviation inspectors were selected for specialized training at FAA's Aeronautical Center in Oklahoma City. The course included training in the psychology of detecting habits or circumstances which lead to pilot error. Later trainees were given a flight refresher course and at least six months of GADO experience before qualifying.

The specialists were trained to look for particular patterns of accidents in specific areas, and for indications of pilot uncertainty over procedures and maneuvers expected of them. They were also briefed on techniques for soliciting local co-operation in accident prevention—such as voluntary removal or marking of obstacles that could be a hazard to flight.

In the two years they have been on the job in the two trial regions, the first contingent of accident prevention specialists have chalked up an impressive record of lowered accident rates and improved pilot-FAA relationships. By releasing some of the General Aviation District Officers from duties of investigating accidents, checking on aircraft and examining pilots, etc., and allowing them to spend all their working hours observing local aviation activity, chatting informally with pilots, and counseling those who sought their help, FAA has provided general aviation airmen with a per-

Full-time accident prevention duties will be carried out by newly assigned specialists at all 78 District Offices by mid 1971. Program will emphasize counselling, teaching safety, with free lectures and seminars.

sonal "flight advisor"—a skilled, veteran flyer who is never too busy to sit down and go over their problems with them—or even to fly with them, when asked.

As a result, the general aviation accident rate has shown a marked reduction in both the trial regions, despite a strong upsurge in general aviation flying hours. In the Central Region, the accident rate per thousand active aircraft was reported to have dropped from 4.52 to 3.90 over a two year period (1967-69). Total accidents fell off from 1,184 in 1968 to 1,145 in 1969. The Southwest Region has released recent accident figures showing the accident rate in 1970 running about 20 percent under that of 1969.

FAA Administrator John H. Shaffer hopes to see the national toll taper off once a full complement of accident prevention specialists takes the field.

Air Bag Restraint for Crash Survival in Light Aircraft Tested

An air bag restraint system in the cockpit of a light airplane showed promise of saving lives in an accident, according to tests conducted at FAA's National Aviation Facilities Experimental Center at Atlantic City.

The bag, made of nylon polyurethane, is stored folded across the top of the pilot's instrument panel. A sudden stop automatically inflates it instantly to cushion the chest and head, preventing front seat occupants from injuring themselves by pitching forward onto the panel.

Designed to inflate fully in 30/100 of a second, the bag deflates gradually after use permitting easy cockpit evacuation. A 5-G deceleration switch activates the safety device, which can be used in conjunction with shoulder restraints or without them. Design work is proceeding on a prototype which might be retrofitted to light aircraft.

World Wide Air Travel Accident Rates Decline to Ten-Year Low in 1969

The fatality accident rates for world-wide scheduled airline passenger service reached a ten-year low in 1969, according to figures released by the International Civil Aviation Organization (ICAO).

The fatal accident rate per 100,000 aircraft hours was 0.27 in 1969, the lowest on record. There were 32 fatal accidents in 1969 in world-wide air carrier travel, causing 1,123 fatalities.

Modified VASI Will Serve Both Large and Small Aircraft

Modification of the standard visual approach slope indicator (VASI) to enable huge jet transports to use the same system serving other aircraft has been approved by FAA. Pilots of such mammoth aircraft as the Boeing 747 and Lockheed C-5A are seated so high above the landing gear that they have a different angle of reference than other aircraft with respect to the runway touchdown point.

The standard VASI consists of two or more light boxes arrayed in two rows (or bars) at either side or both sides of the runway threshold. If the pilot on approach is below the safe glide path, both bars will show red. If he is above the proper glide path, both bars will show white. When he is on the proper glide slope, the first bar (nearest him) shows white and the second bar (farthest away) shows red.

The newly modified VASI, called the three-bar VASI, has a third row of light boxes placed still farther from the approaching aircraft. Pilots of the so-called long-bodied jets, such as the 747, will use only the second and third bars of lights. This will have the effect of moving their aiming point further down the runway, but because the landing gear is so far below the pilot's position, their touchdown point will be approximately the same as other aircraft which are using the first and second bars of lights.

Three-bar VASI systems are designed for runways serving long-bodied aircraft but not equipped with an electronic glide slope. The first installation is scheduled for Los Angeles International Airport in the near future.

MAKE WAY FOR SAIL. Boat bridge on highway leading into Hollywood, Fla., temporarily impedes progress of aviation. Aircraft on road were en route to exhibit at AOPA Plantation Party. *(Photo, Murray Spitzer)*

• Vegaly Familiar

I am sure that I am not the first to tell you that the Lockheed *Vega* on p. 12 of the September issue of FAA AVIATION NEWS is either the only low-wing *Vega* in the world—or else it is in reality an *Orion*. Incidentally, the "star" classics—Vega, Sirius, Orion, Altair—had wooden fuselages, not metal. Otherwise the article was well put together.

Gerald LaPointe
Wausau, Wisconsin

An Orion by any other name is still an Orion—right you are on both counts. The real Lockheed Vega *is shown here. Thanks to all who wrote in.*

• Take Aim

The article in August 1970 FAA AVIATION NEWS entitled "TCA and the VFR Pilot" certainly added some confusion. For the pilot who didn't read the diagram in the Airman's Information Manual, it was impossible to reach the VFR corridor. Just a few words in current AIM cleared this up. "VFR Corridor—Enter/leave corridor beneath Area D."

I hope there are no VFR pilots still circling the Atlanta TCA looking for the VFR corridor entrance.

Frank A. Alexander, Jr.
West Boylston, Mass.

We hope so too! AIM should be consulted before flying into any high density area—both for overall guidance and notification of recent changes.

• Handle with Care

I propose that FAA consider a code designation on IFR Flight Plans, which would tell the controller that the pilot was either a newly rated instrument pilot, considered himself to be marginal or rusty on instrument usage, or was flying into unfamiliar environment. The pilot filing a flight plan could indicate by the code whether he fell into any of these categories—if he wished. The controller could then adjust his handling of the flight to account for this.

Donald V. Organ
New Orleans, La.

FAA has tried such a program on a test basis in the Southern Region. Instrument rated pilots with limited experience were encouraged to fly in the IFR system. A special flight plan was used to identify these pilots and controllers provided these pilots with "door to door" handling. Controllers made sure these pilots understood their clearance, assigned altitude, heading, frequencies, and other items of critical nature. Pilots participating in this program were asked to fill out and mail a brief questionnaire. Only 37 response cards were received from a total of 708 participants, indicating a lack of interest. FAA does have a program whereby student pilots may identify themselves to ATC facilities (See AIM, Part 1, page 105).

• Opportunities in Civil Aviation

For many years I have been interested in training programs for American youth to assure an adequate supply of pilots and mechanics for our future needs. I understand that studies have been made which predict future requirements in these two areas. I would appreciate being brought up to date on this subject.

Robert D. Allred
Toledo, Ohio

The Department of Labor has recently completed a study of manpower requirements for pilots and mechanics in civil aviation. While no shortage of qualified pilots is foreseen, the demand for fully qualified and certificated airplane electricians, electronics and instrument mechanics and radio and avionics technicians, as well as airframe and powerplant mechanics, is expected to exceed the supply. Copies of the report, BSL Bulletin 1655, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402, at a cost of $1.00 each.

• Surprise Landing

May I congratulate you on your practical series entitled "Blind Spots." Incidentially, I know of an interesting accident that came about due to a "blind spot." A Piper Aztec was making a straight-in low approach to the runway at Limon, Costa Rica. A Cessna with a belly pack was making a controlled spiralling descent to the same runway. As the Aztec touched down the Cessna landed on top. They both had the same speed and both went off the runway, the Cessna riding the Aztec piggyback.

The Cessna suffered only the loss of the cargo belly pack and a slightly damaged propeller blade while the Aztec had its landing gear folded aft and sideways. No injuries, luckily, but some surprise, eh?

William H. Kivett
Tegucigalpa, Honduras

• Humidity vs. Horsepower

What effect on wing lift and propeller efficiency does humidity have? From all I've studied about weather and aerodynamics, I've yet to find an in-depth discussion of this problem. And a problem it has been on several occasions involving early morning takeoffs. The air at these times was dead and damp feeling, but not as damp as my brow as I tried to clear electrical lines at the end of the runway, something I usually clear so easily they are of no concern even on hot, windless days.

Richard U. Strasser
Skokie, Illinois

Humidity has no appreciable effect on wing lift and propeller efficiency since any change in air density due to relative high humidity is negligible. However, humidity can have a pronounced effect on engine power since the presence of water vapor in the combustion process can result in an over-rich mixture and a loss of rpm. A loss of from 5 to 10 percent in engine horsepower may be anticipated under conditions of excessive humidity and heat such as may be encountered in tropical environments. See "Wet Air" page 4, this issue.

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

• A Loop in Time

I have a question about Mr. Clifford's enjoyable article in the September issue of your fine magazine: Could Mr. Stearman have seen Clyde Cessna "looping the loop" in 1910?

I thought Adolph Pegoud's loop (an outside loop, at that) in September 1913 was the first one the world had seen. Wasn't the first loop in the United States flown by the famous aerobatic pilot, Lincoln Beachy, in November 1913.

Paul C. Heintz
Radnor, Pa.

Yes. Clifford was ahead of his time.

• How to Buy An Airport

The City of Colton, California, is in the process of acquiring a municipal airport facility. We need information about acquiring a fixed base operator—can you help?

C. Glenn Wilson, City Manager
Colton, Calif.

FAA Advisory Circular 150/5190.1, Minimum Standards for Commercial Aeronautical Activities on Public Airports, discusses the kinds of services a fixed base operator may be required to provide at a public airport. It is aimed primarily at airports developed in some part with Federal aid; however, the information can be applied to all airport situations. Airport owners seeking competent fixed base operator applicants customarily advertise for them in aviation magazines or house organs of aviation trade organizations. Contact with organizations such as the American Association of Airport Executives and the National Aviation Trades Association would be helpful, especially with regard to lease and management agreements.

• Farming from the Air

I read an old copy of FAA AVIATION NEWS with an article concerning patterns and procedures for use by agricultural pilots. I would like to have a reprint of this article and any other data and research on agricultural flying which is available. I am trying to break into this business and can use any information I can find.

Henry C. Waterer, Jr.
Tchula, Mississippi

Articles on crop dusting and flying techniques for aerial applicators appeared in June and September 1968 and April and May 1969.

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